PROPOSED PLAN

ST. LOUIS ORDNANCE PLANT
FORMER HANLEY AREA
ST. LOUIS, MISSOURI

Prepared by

U.S. Army Corps of Engineers Kansas City District	**88th Regional Support Command**	**U.S. Army Environmental Command**

November 2010

1.0 INTRODUCTION

This **proposed plan**[1] (PP) identifies a **preferred alternative** for addressing the contaminated soil and **groundwater** at the St. Louis Ordnance Plant, former Hanley Area, in St. Louis, Missouri (Figure 1). It provides site background and characteristics, summary of risks, **remedial action objectives** (RAOs), the remedial alternatives considered during the **feasibility study** (FS), and describes the preferred alternative.

The Army serves as the lead agency for the former Hanley Area. The U.S. Army Environmental Command (USAEC) provides management and oversight of cleanup activities at active Army and Reserve installations and is the responsible agency for cleanup activities at this site, which is owned by the 88th Regional Support Command (RSC). Additionally, the U.S. Army Corps of Engineers (USACE) Kansas City District provides environmental technical assistance to the USAEC in support of their cleanup activities at this site. This PP was developed by the Army with support from the Missouri Department of Natural Resources (MDNR). The U.S. Environmental Protection Agency (USEPA) Region 7 performs regulatory assistance to MDNR. Although the former Hanley Area is not on the National Priorities List, the Army follows the **Comprehensive Environmental Response, Compensation and Liability Act** (CERCLA) process and the **National Oil and Hazardous Substances Pollution Contingency Plan** (NCP).

The purpose of the PP is to solicit public participation on the preferred alternative as required under Section 117a of CERCLA and Section 300.430(f)(2) of the NCP. The intent is to give citizens an opportunity to submit written or oral comments and to participate in a public meeting during the public comment period (Table 1). The Army may modify the preferred alternative or select another if public comments or additional data indicate a more appropriate remedy.

2.0 OPPORTUNITIES FOR PUBLIC INVOLVEMENT

The Army will select a final remedy for contamination at the former Hanley Area after reviewing and considering all comments submitted during the 30-day public comment period. The Army, in consultation with USAEC and MDNR, may modify the preferred alternative or select another alternative presented in this plan

TABLE 1: UPCOMING EVENTS	
PUBLIC COMMENT PERIOD: November 29 – December 29, 2010	The Army will accept written comments on the PP during the public comment period.
PUBLIC MEETING: December 13, 2010 6:00 pm Julia Davis Branch Library 4415 Natural Bridge Ave. St. Louis, Missouri 63115 Phone: (314) 383-3021	The Army will hold a public meeting to solicit comments from the public. Oral and written comments will be accepted at the meeting. Written comments may also be submitted within 30 days of release of the PP to the following address: Ms. Josephine Newton-Lund CENWK-PM-ES USACE-Kansas City District 601 East 12th Street Kansas City, MO 64106 Phone: (816) 389-3912 Email: Josephine.M.Newton-lund@usace.army.mil
For additional information, review the administrative record at:	Julia Davis Branch Library 4415 Natural Bridge Ave. St. Louis, Missouri 63115 (314) 383-3021

[1] Terms appearing in bold font are defined in a glossary at the end of the Proposed Plan.

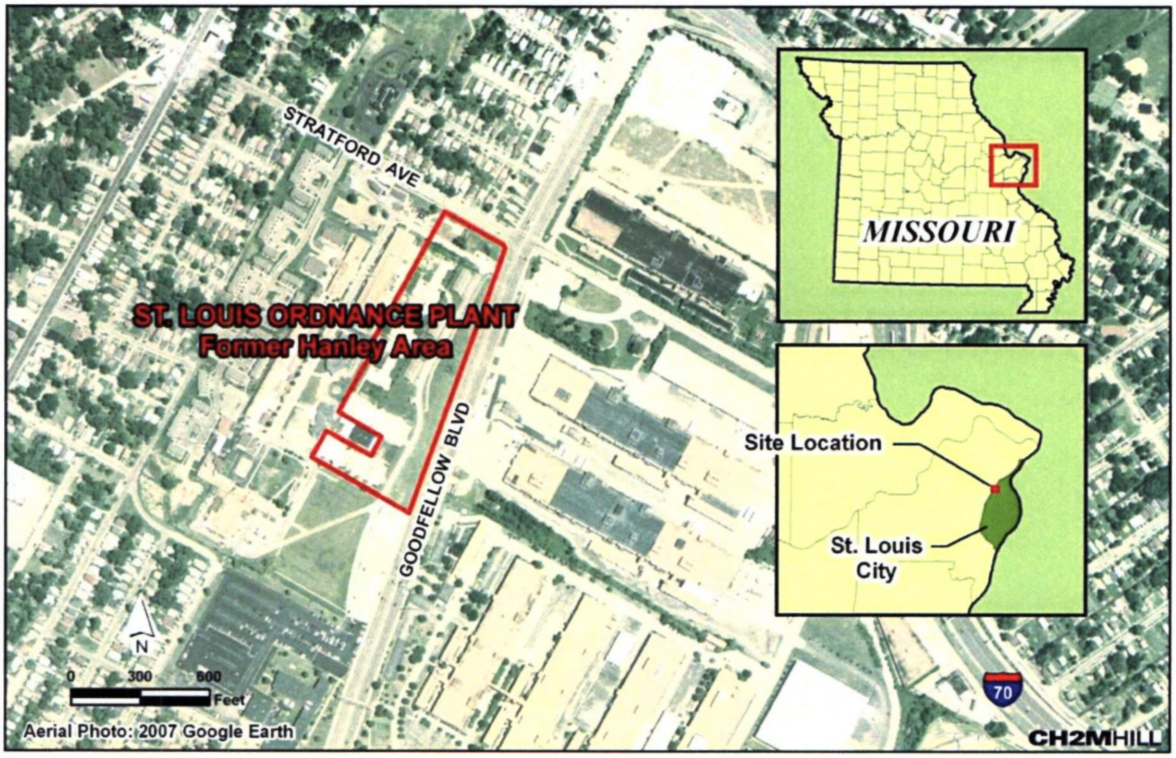

Figure 1: Site Vicinity Map

based on new information or public comments; therefore, the public is encouraged to review and comment on the alternatives presented in this PP.

Response to public comments will be provided in the **decision document** as part of the Responsiveness Summary.

The decision document will present the final selected remedy for the sites.

More detailed information regarding the former Hanley Area, including documents such as the **remedial investigation** (RI) and FS reports, is available in the **administrative record** file for the site at the Julia Davis Branch Library, 4415 Natural Bridge Avenue, St. Louis, Missouri. The public is encouraged to review this information.

3.0 SITE BACKGROUND

3.1 Site Location

The former Hanley Area (Facility ID MO030) is located at 6400 Stratford Avenue on the western boundary of the city limits of St. Louis, 0.25 mile south of the intersection of I-70 and Goodfellow Boulevard (Figure 1). The site is north of the MG Leif J. Sverdrup U.S. Army Reserve Center #3 (Facility ID MO028), located at 4301 Goodfellow Boulevard in St. Louis.

3.2 Site History

The St. Louis Ordnance Plant operated from 1941 to 1945 as a small arms ammunition production facility. The ordnance plant primarily produced .30- and .50-caliber ammunition. The plant was divided into two areas designated No. 1 (east of Goodfellow Boulevard) and No. 2 (west of Goodfellow Boulevard). Plant Area No. 2 encompassed

27.68 acres. The former Hanley Area consists of the 14.68 acres at the northeastern end of Plant Area No. 2 at the intersection of Stratford Avenue and Goodfellow Boulevard. The processes there consisted of the blending of primary explosives, incendiary compounds, and the tracer charging of .30- and .50-caliber projectiles as part of the assembly of the final product. Powder wells installed in 1941 received wastewater from buildings and magazines until 1945. The powder wells provided sediment collection before discharge to the sanitary sewer.

From 1945 through 1959, some buildings within Plant Area No. 2 were used by the U.S. Army Adjutant General's Office for maintaining service records. Other buildings within Plant Area No. 2 were used as classrooms by the Department of Defense Finance Center.

The former Hanley Area takes its name from Hanley Industries, Inc., which leased the 14.68 acres in 1959 and conducted operations there through 1979. Hanley used the site for research, development, manufacture, and testing of various explosives. Over that time, Hanley produced specialty ordnance and non-ordnance devices for the U.S. military and the National Aeronautics and Space Administration. Hanley used most of the buildings to load detonators and primers and to mix explosives. Explosives were dried in magazines by leaving cans of explosives exposed to the air, and a lead azide reactor was operated in one of the magazines, the location of which is unknown. Hanley reportedly did not use the powder wells or sumps on the property for wastewater disposal.

It is suspected that soil and groundwater contamination observed at the former Hanley Area is related to previous waste handling, generation, and disposal processes. The explosives manufacturing process may have resulted in metal contamination in soil, and laboratory and maintenance activities at former Building 220 may have released **polycyclic aromatic hydrocarbons** (PAHs) in soil and **volatile organic compounds** (VOCs) in soil and groundwater. A leaking transformer resulted in a release of Aroclor 1260, a **polychlorinated biphenyl** (PCB), in soil.

It is noted in the June 1981 U.S. Army Toxic and Hazardous Materials Agency *Survey of Hazardous Chemical Area No. 2 of the Former St. Louis Ordnance Plant* that Hanley Industries, Inc., disposed of explosives-contaminated material by burning it in the basement of Building 218C between 1959 and 1979. Open burning of explosives was also conducted in magazines 219F and 219J.

The Goodfellow U.S. Army Reserve Center (now the Sverdrup U.S. Army Reserve Center) was established on the remaining 13 acres of Plant Area No. 2. Some of the western parts of the 13 acres subsequently were transferred to the U.S. Department of Labor, and the land is currently occupied by the Job Corps. Most of the Hanley Area housed a series of warehouse buildings, bunkers, and related buildings. Between 2004 and 2007, buildings and bunkers, with the exception of Buildings 219A, 219D, 219G, and 236, were demolished by an 89th Regional Readiness Command (RRC) contractor. Until it was disestablished in June 2009, the 89th RRC owned the former Hanley Area. The 88th RSC now owns the site and occupies the Sverdrup U.S. Army Reserve Center south of the site.

3.3 Current and Surrounding Land Use

Current site features are shown on Figure 2. The Hanley Area is bordered by the Job Corps facility on the west and residential areas to the north, west, and southwest. The area to the east was formerly part of the St. Louis Ordnance Plant and is now owned by the General Services Administration. The site and surrounding area is zoned industrial,

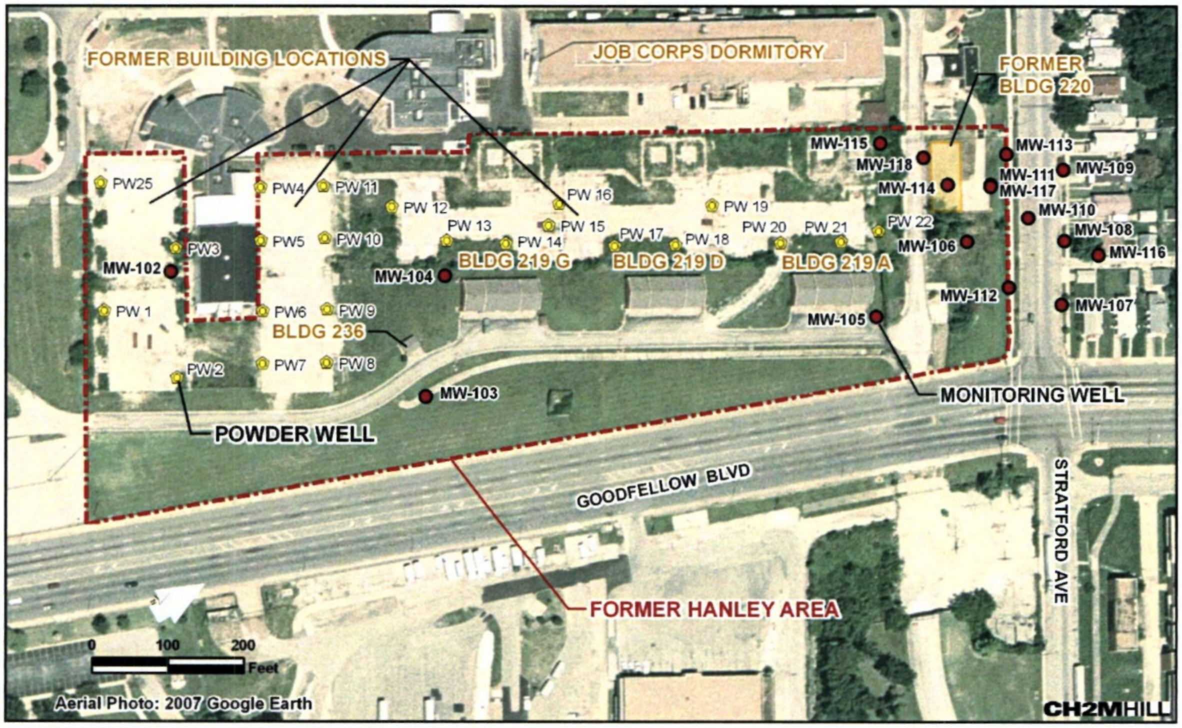

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Figure 2: Current Site Features

commercial, and residential. The site is completely fenced (partially with iron fencing and the remaining with a 6-foot-tall chain link fence).

The site contains underground rooms (former basements and bunkers), tunnels for service utilities, and a combined underground wastewater and stormwater collection system. The underground structures are still intact.

The only remaining buildings and bunkers are Buildings 219A, 219D, 219G, and 236. According to the 88th RSC, only Building 219G is occupied. Buildings 236, 219A, and 219D are used for storage only. Building 219G is occupied during business hours.

3.4 Investigation History

Environmental investigations at the former Hanley Area have been conducted since 1979. The investigation history and findings are summarized in Table 2.

3.5 Summary of Removal and Remedial Actions to Date

No remedial actions at the St. Louis Ordnance Plant have occurred to date. However, decontamination efforts and demolition of buildings, bunkers, and magazines have been completed throughout the operational history of the site.

According to the 1991 *Environmental Study* by U.S. Toxic and Hazardous Material Agency, following deactivation of the St. Louis Ordnance Plant in 1945, buildings having explosives contamination were decontaminated by USACE, reportedly in accordance with regulations of the Safety and Security Branch Office, Chief of Ordnance, Chicago. Although no records are available that describe the procedures employed or the results obtained in the decontamination project, many of the buildings bore markings of "XXX," signifying 99.9 percent clean. This mark is typically used to indicate decontamination and inspection following decontamination to verify safety and absence of explosives contamination. With the exception of the powder wells, magazines and buildings throughout the former Hanley Area were marked "XXX."

The Army required Hanley Industries, Inc., to conduct decontamination of buildings following lease termination in 1979. Decontamination procedures reportedly consisted of spray-washing the walls in the buildings to a height of 8 feet above the floor. None of the magazines were spray-washed. Washdown wastewater from decontamination activities was discharged onto the ground surface outside the buildings.

According to the May 2005 USACE *Technical Memorandum—Final Hanley Area Phase I Remedial Investigation*, Buildings 218A, 218B, and 218C were demolished by the 89th RRC in the summer of 2004. Building 219B was demolished in 2005.

The June 2007 USACE *Final Supplemental Soil and Groundwater Phase II Remedial Investigation Technical Memorandum* stated that Building 220 was demolished in March 2007. According to the 2004 SCS Engineers *Building 220, Guard House, and Harboad Street Bridge Demolition and Site Restoration Report*, 54 loads of clean fill were brought in to fill the void at former Building 220, and finish grading was completed to match the surrounding topography.

3.6 Community Involvement

In April 2004, the Army began community involvement efforts for environmental activities at the former Hanley Area, and the administrative record file was established at the St. Louis Central Public Library. A notice announcing the availability of the file and points of contact for the USAEC and USACE Kansas City District was published in the *St. Louis Post-Dispatch* and *The St. Louis American* in January 2005.

In June 2006, nearby residents were mailed a letter informing them of the Army's investigation of potential groundwater contamination in the vicinity of the former Hanley Area. A second letter dated September 17, 2007, notified residents and property owners that the Army would be seeking access to some properties to collect environmental samples.

The Army has coordinated with the neighborhood's alderman and Job Corps training center staff on an ongoing basis.

4.0 SITE CHARACTERISTICS

The following subsections discuss the site characteristics for the former Hanley Area.

4.1 Soil and Bedrock Characteristics

Overburden soils at the site consist primarily of **lean clay**. The soil lithology is relatively consistent across the site. Fill material including gravel, concrete rubble, brick debris, and sand was observed in portions of the site as deep as 11 feet. Lean clay was observed roughly 20 to 25 feet below ground (514.2 to 509.3 feet in elevation) in the north part of the former Hanley Area. Discontinuous **lenses** of silt were observed within the lean clay. A fat clay layer of varying thickness underlies the lean clay. A hard, dry, completely **weathered shale** with discontinuous lenses of silt and clay underlies the clay.

The discontinuous lenses of silt and clay within the weathered shale are likely the result of differential weathering along **bedding planes**, based on visual observations during the 2008 field investigation in the northern part of the former Hanley Area. The thickness of the weathered shale ranges from 6 to 12 feet in boreholes advanced to depths at which the competent **bedrock** was encountered.

TABLE 2: CHRONOLOGY OF SITE INVESTIGATIONS

PRELIMINARY ASSESSMENTS/SITE INSPECTIONS

1979 and 1980 – Site Investigation by Battelle Columbus Laboratories

The Battelle study was performed at the current site of the Job Corps Training Center and former Hanley Area. Existing buildings, magazines, sewer pipe locations, and powder wells were sampled and analyzed for explosives and metals to assess whether explosive and metal residues remained after previous decontamination efforts. Results indicated the presence of potential explosives and metals residues on building surfaces, in powder wells, and on other structures associated with munitions production, packing, or storage activities.

1991 – Environmental Study by U.S. Army Toxic and Hazardous Materials Agency

Surface and shallow soil samples and tunnel water samples were collected. Lead concentrations in surface soil exceeded site-specific and regional background values. No explosives were detected in the soil samples. **Semivolatile organic compounds** (SVOCs) were detected in trace locations at five locations. Aroclor 1260 was detected in one soil sample at a concentration of 18,200 **milligrams per kilogram** (mg/kg) at the location of a former leaking transformer.

1998 – Site Investigation by HARZA Environmental Services, Inc.

The investigation assessed the presence of chemicals in soil and sediment. Surface and shallow soil samples were collected and analyzed for VOCs, SVOCs, explosives, and **Resource Conservation and Recovery Act** (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). Subsurface soil, sewer sediment, and powder well sediment samples were collected and analyzed for explosives and RCRA metals. Explosives and elevated lead concentrations were detected in surface and shallow soil samples in one location. Arsenic concentrations ranging between 5.0 mg/kg and 67.7 mg/kg were also identified. Silver was found at a maximum concentration of 82.6 mg/kg in a shallow soil sample at one location.

2001 – Preliminary Assessment/Site Inspection by TapanAm Associates, Inc.

The preliminary assessment/site inspection evaluated the extent of surface soil contamination, the potential for contaminant migration by surface routes through underground utility tunnels, and the potential for groundwater contamination. Surface soil, subsurface soil, sediment, and groundwater samples were analyzed for one or more of the following parameters: VOCs, explosives, and **target analyte list** (TAL) metals. Surface soil samples were collected in the northern part of the site around the Building 219 series. Subsurface soil samples were collected near sewer line breaks and two near powder wells. Direct-push probes/temporary piezometers were installed and groundwater samples were collected for chemical analysis. Five monitoring wells were installed and sampled. Sediment samples were also collected from powder wells, sewers, and tunnels. Water samples were collected from sewer locations.

Arsenic, lead, and thallium were found in soil samples at concentrations exceeding USEPA Region 9 **preliminary remediation goals** (PRGs) for residential soil. No explosives were detected in surface soil, and no explosives or VOCs were detected in subsurface soil. Lead concentrations exceeding the PRG were found in powder well sediment as well as low concentrations of explosives. The VOC *cis*-1,2-dichloroethene (*cis*-1,2-DCE) was detected in groundwater at one well, upgradient of the former Hanley Area, slightly above the **maximum contaminant level** (MCL). No other VOCs were above the MCL, and no explosives were detected in groundwater.

2003 – Limited Phase II Environmental Site Assessment by Shaw Environmental

The environmental site assessment further assessed offsite upgradient VOC contamination found during the preliminary assessment/site inspection. Direct-push samples were collected near the monitoring well to assess the presence of VOCs in soil and then converted to temporary monitoring wells, and groundwater was sampled and analyzed for VOCs. No VOCs were detected in subsurface soil. Concentrations of *cis*-1,2-DCE, *trans*-1,2-Dichloroethene (*trans*-1,2-DCE), and vinyl chloride were detected in groundwater.

TABLE 2: CHRONOLOGY OF SITE INVESTIGATIONS
2003 – Phase I Environmental Site Assessment by Pangea
Asbestos samples were collected from onsite buildings during the Phase I environmental site assessment.
REMEDIAL INVESTIGATIONS
2004 – Sampling, Asbestos Abatement, and Building Demolition by SCS Engineers
Sampling of sediment and building materials were collected and analyzed for explosives and metals. Asbestos abatement was performed in the buildings, which were then demolished.
2004 – Environmental Data Compilation by USACE
The USACE compiled environmental data from the previous investigations and identified data gaps.
2005 – Phase I RI by USACE
The USACE performed a Phase I RI to fill data gaps. Composite and discrete surface soil samples were collected in areas where metals had been previously identified in surface soil. The samples were analyzed for TAL metals. Some of the samples were also analyzed for PAHs. Surface soil samples were collected for PCB analysis from the area of the former transformer, located near the southern site boundary. Subsurface soil samples were collected from soil borings advanced adjacent to powder wells, sewer lines, and foundations. One monitoring well was installed downgradient from former Building 220. The new well and five existing wells were sampled and analyzed for explosives, VOCs, and TAL metals. Investigation results identified an area of localized PCB contamination near the former leaking transformer along the southern site boundary. Site-related metals were found to be localized and limited to surface and near-surface soil. It was concluded that subsurface soil was not contaminated. Groundwater in the upgradient well, MW-01, was contaminated with benzene and the **chlorinated volatile organic compounds** (cVOCs) *cis*-1,2-DCE, *trans*-1,2-DCE, and trichloroethene (TCE). The newly installed well, MW-106, on the northern part of the site, exhibited detections of tetrachloroethene (PCE) and 1,2-dichloroethane (1,2-DCA). Various metals were also detected in groundwater.
2005 and 2006 – Supplemental Groundwater RI by USACE
In 2005, direct-push borings/temporary piezometers were installed and sampled near former Building 220 to assess the origin and extent of 1,2-DCA in groundwater in MW-106. Results indicated that groundwater was contaminated with PCE, TCE, carbon tetrachloride (CT), and chloroform. Based on these results, activities were conducted in February 2006 to assess the extent of groundwater contamination. Temporary piezometers were installed, and groundwater samples were collected. Existing monitoring wells were also sampled. Results from the temporary piezometers indicated a presence of PCE, TCE, *cis*-1,2-DCE, 1,2-DCA, and CT in groundwater. Benzene, *cis*-1,2-DCE, *trans*-1,2-DCE, TCE, and vinyl chloride were detected at upgradient well MW-101. PCE and 1,2-DCA were detected at MW-106. Various metals were detected in each monitoring well, but no explosives were detected. Based the February 2006 findings, field activities were implemented in July 2006. Direct-push borings were advanced and groundwater samples collected around former Building 220. Samples were analyzed using **field gas chromatography** for VOCs and submitted for laboratory analysis. PCE, TCE, *cis*-1,2-DCE, chloroform, and 1,2-DCA were detected in the direct-push samples. The gas chromatography confirmed presence of cVOCs. Sediment samples were collected from the two sewer inlets that drain water from the concrete pad north of former Building 220. PCE was the only VOC detected in sediment.
2007 – Supplemental Groundwater Phase II RI by USACE
Additional groundwater investigations were undertaken in January 2007. **Membrane interface probes (MIPs)** were advanced to top of bedrock, north and northeast of the former Building 220 where previous direct-push probes showed high PCE and 1,2-DCA concentrations. Direct-push soil borings were advanced adjacent to and stepped out from the MIP locations for confirmation samples and to determine the extent of VOC contamination in the surface and subsurface soil. Seven monitoring wells were installed in the area northeast of Building 220 and along Stratford Avenue to monitor the interior and boundaries of the VOC contamination observed during the direct-push

TABLE 2: CHRONOLOGY OF SITE INVESTIGATIONS
groundwater investigations. Additional work was completed in March and April 2007. Soil borings were advanced in the area observed impact northeast of the former Building 220. One monitoring well was installed upgradient of the affected area within the footprint of the former Building 220. Groundwater samples were also collected from the eight new wells and one existing well, MW-106, and analyzed for VOCs. PCE and its breakdown products TCE, *cis*-1,2-DCE, and *trans*-1,2-DCE were present in each soil boring and it was also detected beneath Stratford Avenue. Groundwater was also found to be contaminated with PCE and associated breakdown products.
2008 – RI by CH2M HILL
The 2008 RI was developed to fill remaining data gaps to fully delineate the nature and extent of contamination at the site. Surface soil samples were collected to characterize lead and arsenic contamination in the surface soil. A MIP/**cone penetrometer test (CPT)** was used to characterize the nature and extent of VOC contamination in soil, soil gas, and groundwater in the area around former Building 220. Following the MIP/CPT investigation, confirmation soil and groundwater samples were collected based on the MIP/CPT data. Using results from the MIP investigation, groundwater grab samples taken from soil borings that were advanced. To further define the nature and extent of cVOC groundwater contamination near and downgradient of former Building 220, one deep and two shallow groundwater monitoring wells were installed. Groundwater samples were collected from the new wells and existing wells in the area of the former Building 220 to confirm the extent of impact of cVOCs on groundwater at the north end of the site. Indoor air sampling was also performed in a residence along Stratford Avenue to assess the potential for vapor intrusion in residences north of the St. Louis Ordnance Plant.
FEASIBILITY STUDY
2010 – FS by CH2M HILL
The FS developed and evaluated remedial alternatives that address potential unacceptable risks to human health and the environment and meet applicable or relevant and appropriate requirements. Remedial action objectives were established based on regulatory requirements, standards, and guidance. General response actions were identified for the site to develop remedial alternatives. Based on the risks present at the site, the following alternatives were developed: Alternative 1, No Action; Alternative 2, In Situ Groundwater Treatment using Thermal Technologies, Soil and Powder Well Sediment Removal, and Offsite Disposal; Alternative 3, In Situ Groundwater Treatment and Soil and Powder Well Sediment Removal and Offsite Disposal; and Alternative 4, Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal, and Offsite Disposal. The alternatives were evaluated against seven feasibility evaluation criteria as defined in the NCP and CERCLA. The preferred alternative is presented in this PP.

4.2 Groundwater Characteristics

Groundwater is present within more permeable silt and clay lenses that are locally discontinuous within the upper clay (lean clay) unit. Saturated conditions were not observed within the weathered shale beneath the clay unit. Groundwater was encountered in a 6-inch saturated coal layer within the competent shale zone. Groundwater within the coal does not appear to be connected to groundwater in the discontinuous silt and clay lenses.

Groundwater generally flows from the south and west to the northeast. There is a local groundwater high west of former Building 220 in the northern part of the site. Groundwater level measurements made during the 2008 field investigation indicate that the horizontal **groundwater gradients** range from 0.054 to 0.019 foot per foot in the northern part of the former Hanley Area and from 0.048 to 0.010 foot per foot in the southern part of the former Hanley Area. The gradients are consistent with those reported in the 2007 RI.

4.3 Nature and Extent of Contamination

To evaluate the nature and extent of contamination at the former Hanley Area, chemical concentrations were compared against conservative risk-based screening levels defined in the RI report. The screening levels assume that **land use controls** (LUCs) are not in place to prohibit **exposure** to site contaminants. LUCs are discussed in Section 8.2.

The extent of soil and groundwater contamination at the former Hanley Area was delineated by an RI performed in 2008, together with previous investigation findings. Onsite soil contamination consisted primarily of metals, with isolated occurrences of PAHs and PCBs. cVOC contamination is present in soil in the northern part of the site, near former Building 220. In groundwater, three dissolved-phase **plumes** consisting primarily of cVOCs were identified in the northern part of the site. No evidence of **dense nonaqueous phase liquid** (DNAPL) was observed during sampling, but elevated concentrations suggest that DNAPL is present.

A **vapor intrusion** investigation and indoor air investigation were also performed in the residential area north of the site; however, no immediate risks to residents were identified.

Surface Soil

Surface soil contamination (0 to 2 feet below ground) across the former Hanley Area consists primarily of metals. Antimony, arsenic, chromium, copper, lead, thallium, selenium, and silver were detected at concentrations greater than the corresponding screening levels in surface soil. With the exception of arsenic at the property boundary, these metals have been delineated. Arsenic contamination on the adjoining Job Corps property is being evaluated by the Job Corps.

PCE and TCE concentrations also exceeded screening levels in the northern part of the former Hanley Area, downgradient from the former Building 220 in 2007. Aroclor 1260 exceeded the screening level near the southern boundary of the former Hanley Area.

Subsurface Soil

Metals and VOCs were measured at concentrations above screening levels in subsurface soil (more than 2 feet below ground) beneath the former Hanley Area. The metals in the subsurface were determined to be naturally occurring, therefore, no further action is needed to address them. Subsurface VOC contamination is present in saturated soil around former Building 220.

VOCs in subsurface soil near former Building 220 are likely related to the migration of the constituents in groundwater. DNAPL was not observed during monitoring well construction at MW-117 or during groundwater sampling activities at MW-111 and MW-117 (Figure 3). However, PCE observed in soil at the 2007 soil boring SB-023 (3,200 mg/kg) at 25 to 26 feet below ground could indicate the presence of DNAPL above the weathered shale.

Groundwater

Dissolved-phase groundwater contamination exists in the northern part of the site, consisting of three distinct plumes containing one or more cVOCs. In addition, other VOCs were detected at concentrations above screening levels in isolated occurrences within and around the plumes.

Plume A—PCE, TCE, and *cis*-1,2-DCE make up Plume A. The sewer system downgradient and northeast of former Building 220 is suspected to be the primary source of Plume A. The presence of TCE and *cis*-1,2-DCE may be attributed to **reductive dechlorination** of PCE. There is no historical record of a single large spill, but sporadic discharge of small quantities of spent product is assumed to have occurred. Figure 3 illustrates the extent of the PCE and TCE at concentrations above the USEPA MCL of 5 micrograms per liter (µg/L) and *cis*-1,2-DCE above the MCL of 70 µg/L. The MCLs were used as the screening levels

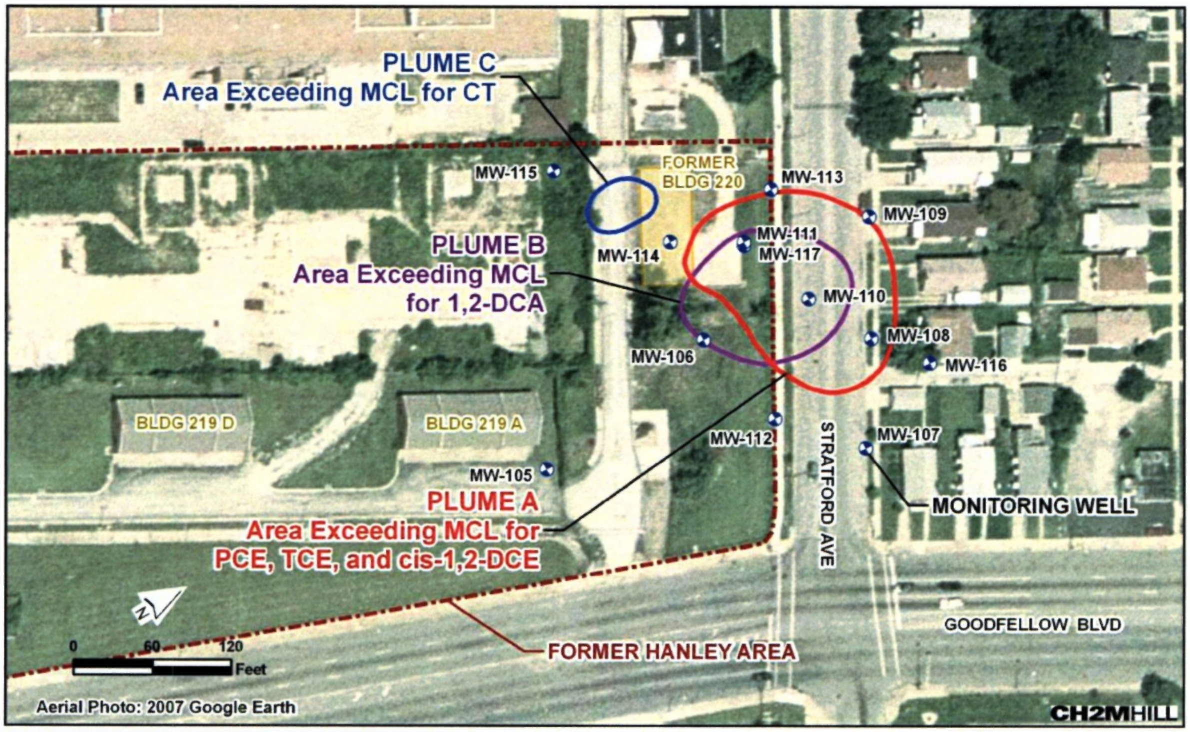

Figure 3. Groundwater at Concentrations Exceeding MCLs

for contaminants in groundwater. The depth of contamination is just below ground to the weathered shale interface at roughly 26 to 28 feet below ground.

Plume B—1,2-DCA makes up Plume B, which is largely commingled with Plume A. The source of Plume B is unknown, but it may be associated with leaks in the sewer collection system. Figure 3 illustrates the extent of Plume B at concentrations above the MCL of 5 µg/L. The depth of contamination is just below ground to the weathered shale interface at roughly 24 to 30 feet below ground.

Plume C—Plume C, southwest of former Building 220, consists of commingled CT, chloroform, and TCE. The source of Plume C is unknown. CT and TCE appear to be the original constituents of the plume, with chloroform present as a breakdown product of CT. The extent of the plume is small and has been delineated in the downgradient direction. Figure 3 illustrates the extent of the CT and TCE at concentrations above the 5 µg/L MCL for drinking water. The depth of contamination is more than 10 feet below ground, which is the estimated depth of groundwater in this area, to the weathered shale interface at roughly 34 feet below ground.

Soil Vapor

A vapor intrusion investigation and indoor air investigation were conducted in March 2008, in the residential area north of the site, across Stratford Avenue, to assess potential vapor intrusion associated with subsurface groundwater contamination, specifically, PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, vinyl chloride, and 1,2-DCA. The field activities included soil gas sampling, indoor and ambient air sampling, and groundwater sampling.

Soil gas samples could not be collected due to the tight expansive clays encountered onsite and offsite. For this reason, the Army, MDNR, and USEPA agreed to investigate the vapor intrusion pathway by sampling indoor air in an offsite residence. The residence is downgradient of the groundwater contaminant plume, it was vacant at the time of sampling, and it did not contain household sources that would affect VOC concentrations in the indoor air samples.

One indoor air sample, collected in March 2008, contained TCE above the low end of the acceptable risk level. Based on this result, an additional round of air samples was collected in May 2008. Results from the May 2008 samples indicated no immediate unacceptable risks to residents.

Powder Well Sediment
In 2001, 22 powder wells were located across the former Hanley Area. Eighteen of the wells contained sediment with various metal concentrations exceeding screening levels. Explosives in powder well samples were not detected at concentrations above the screening levels.

5.0 SCOPE AND ROLE OF RESPONSE ACTION

The FS report identified remedial alternatives and evaluated them to choose the preferred remedy for the former Hanley Area. The preferred alternative will be the final response action for the site. The object is to eliminate the potential for exposure to contaminants in groundwater and soil at concentrations that could pose a risk. The concentrations considered acceptable to leave in place are called the **remediation goals**. These will be identified in the decision document following the public's review of the PP. The implementation of the remedy will also comply with **Applicable or Relevant and Appropriate Requirements** (ARARs) and achieve the RAOs for the site.

6.0 SUMMARY OF SITE RISKS

As part of the RI, a **human health risk assessment** (HHRA) and an **ecological risk assessment** were performed to evaluate the potential risk posed to human health and the environment if no **remedial action** was performed. This section presents a summary of the findings of the assessments. A more detailed summary can be found in the RI report.

Based on the HHRA, it is the Army's current judgment that the preferred alternative identified in this PP, or one of the other active measures considered in the PP, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

6.1 Human Health Risk Assessment

A HHRA was performed to evaluate potential current and future risks associated with constituents detected at the site in the surface soil, subsurface soil, groundwater, and indoor air samples. Although the current land use at the former Hanley Area is industrial, the HHRA considered the possibility that the property would be redeveloped for residential land use in the future.

Chemicals contributing to human health risk in soil are antimony, arsenic, Aroclor 1260, lead, and thallium, whereas those in groundwater are primarily various cVOCs. Eighteen of the 22 powder wells contain sediment with various metal concentrations that exceed screening levels. Alternatives to address the contamination were developed and evaluated during an FS. The RI and FS reports are part of the administrative record.

Soil
MDNR, Missouri Department of Health and Senior Services (MDHSS), USEPA, and Army agreed that certain areas of soil with elevated arsenic, lead, and Aroclor 1260 concentrations would be removed and therefore excluded from the HHRA. The areas will be addressed through a soil removal action during remedy implementation, as described in Section 8.2. The remaining

concentrations of arsenic, lead, and Aroclor 1260 were included in the HHRA.

The HHRA evaluated residential exposure to onsite subsurface soil by dividing the site into hypothetical exposure units, roughly the size of 1-acre residential lots. Risk estimates were calculated within each exposure unit to address concerns regarding possible concentration dilution. For HHRA purposes, soil from the 0- to-10-foot-depth range was evaluated for potential future residential exposure, since soil currently situated greater than 2 feet in depth could be brought to the surface during future redevelopment.

The HHRA calculated risk estimates for current industrial workers to surface soil (0 to 2 feet below ground) and for future construction worker exposure to subsurface soil (0 to 10 feet below ground). No unacceptable risks associated with these **exposure pathways** were found.

In the HHRA, antimony and thallium were identified as **chemicals of concern** (COCs) for potential future residential exposure to soil. COCs are chemicals that yield an **individual excess lifetime cancer risk** greater than 1×10^{-5} or an individual **hazard index** greater than 0.1 contributing to a target organ hazard index greater than 1.0. An individual excess lifetime cancer risk of 1×10^{-5} means that an individual exposed to a given chemical concentration for a lifetime would have an increased chance of developing cancer of one in 100,000. A hazard index of 1 or less is considered highly unlikely to cause noncancer adverse effects even if exposure continues for a lifetime.

Groundwater

The HHRA calculated risk estimates to residents, construction workers, and industrial workers exposed to onsite and offsite groundwater. Groundwater at the site is not used for potable purposes, and offsite residents do not use groundwater as a potable water supply. St. Louis City Ordinance 66777 prohibits the installation of potable water supply wells.

Hypothetical potable use of groundwater was evaluated in the HHRA at the request of MDNR and MDHSS, even though the current and future exposure pathways are incomplete because of the City Ordinance.

The following groundwater COCs were identified:

- Onsite Groundwater
  - Tap water (Resident)—benzene, CT, chloroform, 1,2-DCA, *cis*-1,2-DCE, *trans*-1,2-DCE, manganese, naphthalene, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, PCE, and TCE
  - Groundwater in Excavation (Construction Worker)—CT (part of Plume C) and PCE (part of Plume A)
- Offsite Groundwater
  - Tap water (Resident)—Chloroform, 1,2-DCA, manganese, PCE, and TCE; the risk estimates for this scenario are driven by the elevated concentrations detected in MW-110, situated in the middle of Stratford Avenue

The HHRA estimated risks to construction workers by assuming that the onsite and offsite groundwater lies within 10 feet below ground, the maximum depth at which the groundwater direct contact pathway for construction workers is considered complete. This assumption overestimates construction worker risk associated with CT in Plume C, where groundwater was estimated to be more than 10 feet below ground. This information was considered during the development of remedial alternatives for the FS.

Indoor Air

As described in Section 4.3, an indoor air sample collected from a vacant offsite residence contained TCE above the low end of the acceptable risk level. Based on this result, an additional round of air samples was collected in May 2008. Results from the May 2008 samples indicated no immediate unacceptable risks to residents.

In the area downgradient from former Building 220, vapor intrusion into a future onsite residential building cannot be adequately predicted with a computer model because the groundwater is too shallow (less than 5 feet). It is expected that future indoor air exposures in onsite buildings constructed in the area would be at unacceptable levels because of the high concentrations (well above groundwater-to-indoor air screening levels) and shallow groundwater depths.

An assumption was made in the HHRA that the concentrations of chemicals in the media evaluated remain constant over time. This assumption could overestimate or underestimate risk, depending on how much the chemicals break down or transport into other media. For instance, if the VOC plume expands in the future, indoor air concentrations at offsite residences could increase; in that case, the HHRA may underestimate future risk for offsite residents. Additional evaluation of indoor air will be part of the selected remedy for this site, as discussed in Section 8.2.

Powder Well Sediment

As part of the remedial action at the former Hanley Area, the 22 powder wells will be decommissioned. The sediment will be removed and disposed based on characterization sampling, and the wells will be filled with clean, imported soil to ground surface. Because the powder well sediment will be addressed through a removal action, risk associated with powder well sediment was not evaluated in the RI report. Additional information regarding powder well sediment removal is provided in Section 8.2.

6.1.1 Summary of COCs

COCs identified in the HHRA consisted of the following:

- Onsite Subsurface Soil (Exposure Units A through L)—Residents:
  - Exposure Unit E—Antimony and thallium
  - Exposure Unit I—Thallium
  - Exposure Unit J—Thallium
  - Exposure Unit K—Thallium
- Groundwater (Area Downgradient of Former Building 220)
  - Tap water (Resident)— benzene, CT, chloroform, 1,2-DCA, *cis*-1,2-DCE, *trans*-1,2-DCE, manganese, naphthalene, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, PCE, and TCE
  - Groundwater in Excavation (Construction Worker)—CT and PCE
- Onsite Groundwater (Sitewide Excluding Area Downgradient of Building 220)
  - Residents—1,2-DCA and CT
- Offsite Groundwater (Residential Tapwater Exposures)
  - Chloroform, 1,2-DCA, manganese, PCE, and TCE; the risk estimates for this scenario are driven by the elevated concentrations detected in MW-110, situated in the middle of Stratford Avenue

6.2 Ecological Risk

Potential risks to terrestrial plants and soil invertebrates are indicated for direct exposure to chromium, lead, manganese, selenium, thallium, vanadium, and zinc.

Available habitat is limited to enclosed and maintained grassy areas. Although plant and invertebrate receptors are present at the site, the habitat does not represent a natural ecosystem, as it is controlled by human activity. The potential for adverse effects to terrestrial plants and soil invertebrates exists, but the nature of the habitat in the regularly disturbed area is likely to limit the diversity and abundance of terrestrial plants and soil invertebrates and the overall potential for adverse effects to receptor communities. The conditions suggest that risks are negligible, and no further investigation is warranted.

7.0 REMEDIAL ACTION OBJECTIVES

RAOs are goals specific to media or operable units for protecting human health and the environment. Typically, RAOs are developed based on the exposure pathways and contaminant levels found to pose potentially unacceptable risks according to the results of the HHRA and ecological risk assessment and to satisfy the ARARs.

As described in Section 6.1, groundwater COCs were identified for the potable use exposure pathway. However, St. Louis Ordinance 66777, which prohibits the installation of potable water supply wells, is already in place as an institutional control and removes the exposure pathway for onsite and offsite receptors to use the groundwater as a potable resource.

COC concentrations in various environmental media at the site pose unacceptable risks to human health based on complete exposure pathways. The following RAOs were developed for the site:

- Prevent unacceptable risk to future human receptors (onsite and offsite) from potential vapor intrusion to indoor air.
- Prevent unacceptable risk to residents from ingestion of onsite soil containing antimony and thallium within certain exposure units.
- Prevent unacceptable risk to onsite construction workers from dermal contact with groundwater containing CT and PCE.
- Remove soil to prevent future human exposure to onsite soil with elevated concentrations of arsenic, lead, and Aroclor 1260 at historical sample locations identified in the RI and FS reports.
- Remove the sediment within onsite powder wells to prevent future human exposures.

7.1 Preliminary Remediation Goals

PRGs are risk- or ARAR-based chemical-specific concentrations that help refine the RAOs. PRGs are considered preliminary; final remedial goals will be defined in the decision document once the remedy is selected. PRGs for the sediment in the powder wells were not calculated because sediment will be removed from the wells as part of the remedial action at the former Hanley Area.

Soil
PRGs identified for soil COCs to prevent unacceptable risk to residents from ingestion of onsite soil containing thallium and antimony and to prevent unacceptable risk to human receptors to onsite soil containing elevated concentrations of arsenic, lead, and Aroclor 1260 consist of the following:

- Thallium 7 mg/kg
- Antimony 31 mg/kg
- Lead 400 mg/kg
- Arsenic 13.2 mg/kg
- Aroclor 1260 1 mg/kg

Groundwater
PRGs identified to prevent unacceptable risk to onsite construction workers for dermal contact with COCs in groundwater consist of the following:

- CT 3,200 µg/L
- PCE 21,000 µg/L

Although they were not identified as COCs in soil, CT and PCE concentrations in unsaturated soil may affect the RAO for construction worker dermal contact with groundwater. Therefore, PRGs were developed for unsaturated soil to address potential ongoing sources of groundwater contamination. The following PRGs were developed:

- CT 1.19 mg/kg
- PCE 9.14 mg/kg

7.2 Target Treatment Zones

Based on the RAOs and the areas with COC concentrations above the PRGs, **target treatment zones** (TTZs) were developed for areas that require further action at the former Hanley Area for surface soil, sediment within the powder wells, and groundwater. The TTZs are identified and described in the summary of remedial alternatives (Section 8.0).

8.0 SUMMARY OF REMEDIAL ALTERNATIVES

The preferred alternative for the former Hanley Area addresses the RAOs identified in Section 7.0, and it consists of the following components:

- In situ groundwater treatment using chemical processes and soil mixing
- Soil removal and offsite disposal
- Powder well sediment removal and offsite disposal
- Vapor intrusion evaluation
- LUCs
- **Five-year site reviews**

The preferred alternative was identified among four remedial alternatives that were developed during the FS phase and is listed as Alternative 3 below. The considered alternatives are discussed briefly below. Additional details can be found in the FS, as part of the administrative record:

- Alternative 1—No action
- Alternative 2—In situ groundwater treatment using thermal technologies, soil and powder well sediment removal, and offsite disposal
- Alternative 3—In situ groundwater treatment using chemical processes and soil mixing, soil and powder well sediment removal, and offsite disposal
- Alternative 4—Groundwater source removal by excavation, soil and powder well sediment removal, and offsite disposal

8.1 Alternative 1—No Action

This alternative is required by the NCP so that a baseline of set conditions can be established against which other remedial actions may be compared. Alternative 1 has no capital or operation and maintenance (O&M) costs. This alternative will not be discussed further in the PP.

Estimated **Capital Cost**:	$0
Estimated Annual O&M:	$0
Estimated **Present Worth:**	$0

8.2 Common Elements among Alternatives 2, 3, and 4

Alternatives 2, 3, and 4 all include removal and offsite disposal of metals and Aroclor 1260–contaminated surface soil to address the soil TTZs (shown as soil removal areas in Figure 4), powder well sediment removal, a vapor intrusion evaluation, and LUCs (Figure 5). Five-year site reviews are included in each alternative as they are required for sites containing COC concentrations above respective remediation goals. The common elements are discussed in the following summary. They have been included as part of the remedy and cost estimates for each of the three alternatives. For cost estimating purposes, the estimated duration of Alternatives 2, 3, and 4 was chosen as 50 years. Although the actual monitoring period may be 100 years, cost estimating periods beyond 50 years have little effect on the present worth estimate.

Soil and Powder Well Sediment Removal and Offsite Disposal
This common element consists of excavating areas of arsenic, lead, thallium, and Aroclor 1260-contaminated surface soil, transporting it offsite, and disposing of it at a permitted landfill. Samples of the soil will be collected for disposal characterization. Before excavation, hand auger soil borings will be advanced to delineate the presence of COCs in soils around previous sample locations.

It is assumed for cost estimating purposes that excavation will be required to a depth of 2 feet below ground in areas not covered with concrete, but the depth will be determined based on confirmation sampling conducted before excavation. Soil samples from the area will be collected and analyzed for the corresponding COC to determine excavation limits. Soil removal areas are shown on Figure 4. The excavated soil will be disposed offsite at a permitted landfill. This element assumes that the excavated soil will not be characterized as hazardous waste. Following excavation and confirmation sampling, the area will be backfilled, regraded, reseeded, and restored to its original condition. Clean, imported material will be used as backfill.

As part of the remedial action at the former Hanley Area, the 22 powder wells will be decommissioned. The sediment will be removed and disposed based on characterization sampling, and the wells will be filled with clean, imported soil to ground surface. The sediment will be disposed offsite at a permitted landfill.

Vapor Intrusion Evaluation
Based on the uncertainty of indoor air risk, the vapor intrusion pathway will be further evaluated as part of the site remedy. Several components may be included in the evaluation, such as:

- Vapor migration information collected from similar sites
- Site-specific VOC data
- Data collection methods developed by the industry
- Vapor intrusion modeling
- Potential risk based on current or future structures

For cost estimating purposes, the vapor intrusion evaluation will include monitoring the VOCs in groundwater that were observed above the screening levels defined in the FS report. The screening levels are based on MCLs or, for chemicals without MCLs, resident risk-based screening levels for potable use. Resident risk-based screening levels for potable use were developed for these chemicals. COC concentrations above the screening levels will be used as a trigger for determining whether additional sampling and/or mitigation actions are necessary. If groundwater concentrations exceed screening levels and are found to increase in monitoring wells along Stratford Avenue, or if other vapor intrusion evaluation measures conclude that there is risk to human receptors, additional sampling or mitigation actions, such as vapor barriers or in-home mitigation systems that vent indoor air to the atmosphere, will be implemented as part of the remedy. In accordance with the Army vapor intrusion policy, proper notification will be given to current property owners (onsite and offsite) of potential vapor intrusion risk.

The details of the vapor intrusion groundwater monitoring program, such as the number and location of wells to be sampled and the frequency, will be provided in the remedial design. For cost estimating, it is assumed that groundwater samples will be conducted quarterly for the first 2 years to establish groundwater trends and areas that may be susceptible to indoor air risk. Following year 2, groundwater samples will be collected annually to monitor the above VOCs at the site to identify changes in the plume that might affect the protectiveness of the selected remedy. Because vapor intrusion is an evolving field, groundwater sampling may be replaced with modeling or other sampling methods, as new technologies become available during the remedial design, remedial action, or long-term management. Data collected as part of the remedial design may be used to adjust the remedial approach if appropriate.

Land Use Controls

LUCs will be implemented onsite at the former Hanley Area in areas where groundwater concentrations exceed screening levels, unless future vapor intrusion evaluations confirm that risk thresholds have not been exceeded. The LUCs will require vapor intrusion evaluations at building construction sites at the former Hanley Area if groundwater concentrations have not fallen below screening levels in the vicinity of the construction site. If results of the vapor intrusion evaluation indicate potential vapor intrusion issues, or if a vapor intrusion evaluation is not performed, vapor intrusion mitigation technology will be applied to address soil gases that could enter the future building.

Within the LUC area described above, a second LUC will be established over the Plume C footprint as long as CT concentrations remain above the groundwater remediation goal. This LUC will prohibit construction activities below the groundwater table without proper health and safety training and personal protective equipment.

The Army will prepare a Land Use Control Implementation Plan (LUCIP) to define restrictions within the LUCs, establish LUC boundaries, and explain how they will be implemented, monitored, and enforced. Upon transfer of property ownership, the Army will include restrictions in the property deed to document the LUCs defined in the LUCIP.

Five-Year Reviews

Five-year site reviews are a common element to be included as long as hazardous substances remain at the site at concentrations that do not allow unlimited use and unrestricted exposure. The 5-year reviews would be terminated once COCs are at or below the remediation goals, the vapor intrusion pathway is determined not to cause unacceptable risk as part of a future vapor intrusion evaluation (or chemical concentrations in groundwater fall below screening levels), and monitoring confirms that no unacceptable risks are posed by Plume C. Once these conditions are confirmed at the former Hanley Area, the 5-year reviews will be recommended for termination. The basis for the recommendation will be documented in a final 5-year review report that will be submitted for regulator approval.

The 5-year review will focus on vapor intrusion, the only potential risk that will not be actively addressed through remedial action, and monitoring results associated with Plume C to confirm that the construction worker risk exposure remains unchanged. The time that **natural attenuation** takes to return groundwater to the potable use levels is estimated to be more than 84 years for Alternatives 2, 3, and 4. This duration is considered comparable to the time required to remove risk associated with vapor intrusion.

8.3 Alternative 2—In Situ Groundwater Treatment Using Thermal Technologies

Alternative 2 relies on **in situ** thermal technologies to decrease PCE concentrations within the Plume A TTZ (Figure 5), which corresponds to the area where groundwater concentrations exceed construction worker PRGs but does not extend into Stratford Avenue.

Thermal treatment processes work by increasing the temperature of the contaminated soil and groundwater through the introduction of steam or electrical energy. The primary in situ heating processes include **steam-enhanced extraction, electrical resistance heating** (ERH), and **thermal conductive heating** (TCH). At the site, TCH is considered the most robust technology because of the clayey hydrogeologic setting. Recent applications have shown that ERH has not performed as well as TCH in clayey sites, since ERH relies on saturated soil conditions in the treatment zone to conduct electrical current effectively. Therefore, TCH technology was used for cost estimating purposes.

Alternative 2 includes treatment of the Plume A TTZ to address direct contact risk to construction worker within Plume A. Groundwater monitoring will be performed within Plume C to confirm that the exposure pathway between construction workers and contaminated groundwater remains incomplete as long as concentrations of CT remain above the risk threshold for direct contact risk to construction workers. Details of the monitoring program, such as number and location of wells to be sampled, will be provided in the remedial design. For cost estimating, it is assumed that groundwater samples and depth-to-water measurements will be conducted quarterly for the first 2 years, followed by a decrease in frequency to annual monitoring. Five-year site reviews will be conducted.

Estimated Capital Cost:	$2,638,000
Estimated Annual O&M: (Years 1 and 2)	$67,000
Estimated Annual O&M: (After Year 2)	$36,000
Estimated Periodic Cost: (Five-year reviews)	$15,000
Estimated Present Worth:	$3,754,000

8.4 Alternative 3 – In Situ Groundwater Treatment Using Chemical Processes and Soil Mixing

Alternative 3 relies on in situ groundwater treatment using chemical processes known as chemical reduction or chemical oxidation to decrease PCE concentrations in the Plume A TTZ (Figure 5). The TTZ will be treated by applying a **chemical reductant** or **oxidant** to in situ soil and groundwater. Chemical reduction using soil mixing procedures was selected as the basis of the cost estimate for this alternative.

Mechanical soil mixing involves using an in situ blender (i.e., large-diameter auger or trenching machine) to effectively distribute chemical amendments throughout the soil medium to treat PCE through reductive dechlorination. This process has been successfully applied at other sites. This process is practicable and implementable at the site and is compatible with the clayey soils found at the site.

A one-pass trenching machine method for soil mixing was assumed in this alternative for cost estimating purposes. The one-pass trenching machine resembles a large chainsaw mounted on an excavator platform. The rotating cutting chain mixes the amendment and soil as it travels along its path. During mixing operations two soil samples will be collected each day at various depths to verify proper mixing and usage of the amendment.

After implementation of soil mixing, groundwater samples will be collected from within the treatment zone and downgradient of the treatment zone to evaluate the impact on COC concentrations in groundwater. Field work to complete soil mixing activities is expected to take about 1 month, with a treatment time of roughly 3 months based on the properties of the **zero valent iron** and chemical concentrations within the Plume A TTZ. PCE concentrations in groundwater may be below PRGs within a year. Five-year site reviews will be conducted.

Estimated Capital Cost:	$1,772,000
Estimated Annual O&M: (Years 1 and 2)	$67,000
Estimated Annual O&M: (After Year 2)	$36,000
Estimated Periodic Cost: (Five-year reviews)	$15,000
Estimated Present Worth:	$2,888,000

8.5 Alternative 4—Groundwater Source Removal by Excavation

Alternative 4 relies on soil removal to decrease PCE concentrations in groundwater within the Plume A TTZ. Soil excavation immediately removes the contaminated media. Alternative 4 combines physical soil removal with disposal at a permitted landfill. The TTZ is consistent with Alternatives 2 and 3 (Figure 5). A remedial design sampling event will delineate the TTZ before soil removal. Contaminated soil will be removed using a backhoe. Contaminated soil above and below the groundwater table will be excavated from the TTZ. Some contaminated soil may have to be left in place if it is not safe or practical to be removed (e.g., would require excavation too close to utilities or the roadway). Excavation near roadways or utilities will be conducted in a manner that protects structural integrity, such as the use of sheet piling.

Excavated soil may be staged temporarily onsite until waste characterization sampling is completed. For estimating purposes, it is assumed that part of the soil will be classified as hazardous waste. Excavated soil will be placed on plastic sheeting and covered with plastic to control dust and emissions and to shield the soil from precipitation. Best management stormwater pollution prevention measures will be implemented.

Following excavation, clean, imported material will be used to backfill the excavation. Fill materials will be placed in the excavation in 1-foot lifts and compacted. The area will be regraded, reseeded, and restored to its original condition. Field work to complete excavation activities is expected to take approximately 2 months, with an immediate treatment time. Five-year site reviews will be conducted.

Estimated Capital Cost:	$1,971,000
Estimated Annual O&M: (Years 1 and 2)	$67,000
Estimated Annual O&M: (After Year 2)	$36,000
Estimated Periodic Cost: (Five-year reviews)	$15,000
Estimated Present Worth:	$3,087,000

9.0 EVALUATION OF REMEDIAL ALTERNATIVES

Alternatives were evaluated in detail using the nine NCP criteria identified in Table 3. The first two cleanup evaluation criteria (overall protection of human health and the environment and compliance with ARARs) are **threshold criteria** that must be met by the selected remedy. The next five criteria (Long-term Effectiveness; Reduction of Toxicity, Mobility, or Volume through Treatment; Short-term Effectiveness; Implementability; and Cost) are **balancing criteria** that are used to evaluate and compare the alternatives. The final two criteria (state/support agency acceptance and community acceptance) are **modifying criteria** that are used to modify the selection of the recommended alternative following the public comment period.

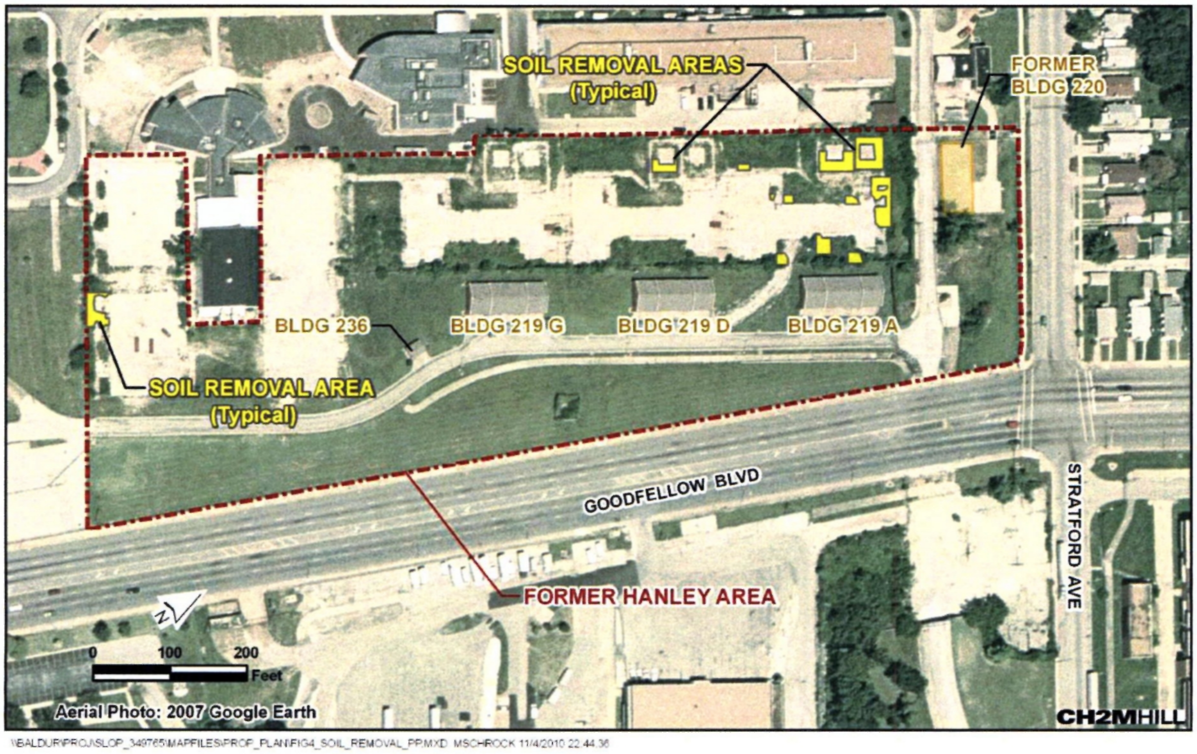

Figure 4: Soil Removal Areas

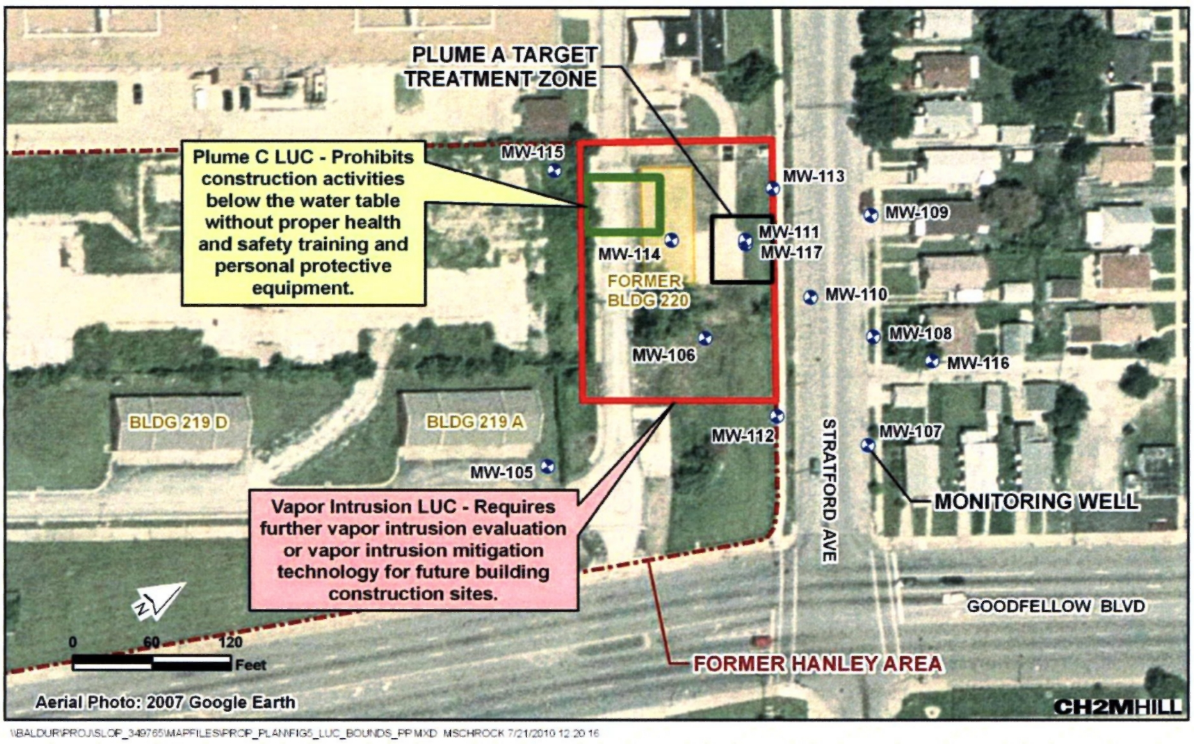

Figure 5: Land Use Control and Target Treatment Zone Boundaries

TABLE 3: NCP EVALUATION CRITERIA
Overall Protectiveness of Human Health and the Environment determines whether an alternative eliminates, decreases, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified. No waivers have been identified for the site.
Long-Term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to decrease the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-Term Effectiveness considers the time needed to implement an alternative and the risk the alternative poses to workers, residents, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and **annual operation and maintenance** costs, as well as present worth cost. Present worth is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to −30 percent.
State/Support Agency Acceptance considers whether the state/support agency agrees with the lead agency's analyses and recommendations, as described in the RI report, FS report, and PP.
Community Acceptance considers whether the community agrees with the lead agency's recommendations and preferred alternative, as described in the PP. Comments received on the PP are an important indicator of community acceptance.

9.1 Overall Protection of Human Health and the Environment

Alternatives 2, 3, and 4 provide protection of human health and the environment by meeting the RAOs. These alternatives rate high in this category. Alternative 1 does not provide protection of human health and the environment. For this reason, it was not considered further in the evaluation of alternatives..

9.2 Compliance with ARARs

Alternatives 2, 3, and 4 are in compliance with the action- and chemical-specific ARARs. Alternatives 2, 3, and 4 are in compliance because the remediation goals would eventually be met at the site. Alternatives 2, 3, and 4 are rated high.

9.3 Long-Term Effectiveness and Permanence

Under Alternatives 2, 3, and 4, there would be no residual risks to potable water use receptors because of an existing City Ordinance. Alternatives 2, 3, and 4 would have no residual risk to soil COCs, and risks to the construction worker would be managed through treatment and control of exposure. Alternatives 2, 3, and 4 would remove the COCs to their remediation goals, and nearby residents would only have a temporary impact due to the noise and increase in roadway traffic because of the excavation activities. Alternatives 2, 3, and 4 were rated high because of their long-term effectiveness and permanence.

9.4 Reduction of Toxicity, Mobility, or Volume through Treatment

For Alternatives 2, 3, and 4, most of the contaminated area would be destroyed or removed from the site resulting in significant reduction of toxicity, mobility, or volume. Natural attenuation would then slowly decrease concentrations of COCs in groundwater over time. Alternative 4, removal by excavation, would not use treatment to decrease the mass of contaminated media. However, Alternatives 2 and 3 would both use treatment therefore meeting the preference for treatment. Alternative 4 received a low ranking because treatment is not part of the alternative. Alternatives 2 and 3 received the highest rating in this category.

9.5 Short-Term Effectiveness

Alternatives 2, 3, and 4 would achieve protection rapidly onsite due to the existing ordinance and depth to groundwater. However, groundwater under Stratford Avenue would not be addressed during the remedial action, therefore protection would not be achieved rapidly offsite.

9.6 Implementability

Alternative 4 would be the easiest to implement and therefore was rated the highest because Alternative 4 does not require treatment. Alternatives 2 and 3 would be feasible but complex due to the nature of the treatment processes. Alternatives 2, 3, and 4 would be reliable and feasible, and materials and services are readily available, except Alternative 2 would likely require an additional power source. Both Alternatives 2 and 3 received a moderate rating.

9.7 Cost

The cost of Alternative 2 is the highest followed by Alternatives 4 and 3. The present worth of the four alternatives is presented in Section 8.

9.8 State/Support Agency Acceptance

Final acceptance from MDNR and USEPA of the preferred alternative will be evaluated after the public comment period ends and will be described in the decision document.

9.9 Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the decision document.

10. PREFERRED REMEDIAL ALTERNATIVE

The preferred remedial alternative for the former Hanley Area is Alternative 3, in situ groundwater treatment using chemical processes and soil mixing, soil and powder well sediment removal offsite disposal, vapor intrusion evaluation, LUCs, and five-year reviews. The preferred alternative was selected over other alternatives for the former Hanley Area because it is expected to most effectively meet RAOs. Based on information currently available, the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs of all alternatives with respect to balancing and modifying criteria. The preferred alternative can change in response to public comment or new information.

11. COMMUNITY PARTICIPATION

The public is encouraged to participate in the decision making process by providing comments on the PP or attending the public meeting.

11.1 Public Comment Period

The public comment period extends from November 29 through December 29, 2010. The public comment period gives citizens an opportunity to provide their views on the PP and the preferred alternative to the Army, which will be documented in the Responsiveness Summary of the decision document. A final decision on the former Hanley Area remedial action will not be made until review of the comments received during the comment period. Comments must be postmarked no later than December 29, 2010.

11.2 Public Meeting

A public meeting will be held at the Julia Davis Branch Library in St. Louis at 6:00 pm on December 13, 2010. The Army and MDNR officials will discuss the PP and answer questions. Questions will be recorded and responded to in writing, and will be considered by the remedy selection official for the Army. At the meeting, the public can verbally comment on the PP or submit written comments.

Location:	Julia Davis Branch Library 4415 Natural Bridge Ave. St. Louis, MO 63115
Time:	6:00 pm
Date:	December 13, 2010

11.3 Administrative Record

The administrative record contains the RI and FS reports, and other materials relied upon in reaching a decision on the selection of the preferred alternative for the former Hanley Area. The administrative record is maintained at:

Julia Davis Branch Library
4415 Natural Bridge Ave.
St. Louis, Missouri 63115

11.4 Contacts

If you have questions about the PP or the public comment period, please contact the following Army personnel:

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This document contains a mail-in form for submitting written comments or information to the Army.

LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
CPT	cone penetrometer test
CT	carbon tetrachloride
cVOC	chlorinated volatile organic compound
1,2-DCA	1,2-dichloroethane
cis-1,2-DCE	*cis*-1,2-dichloroethene
trans-1,2-DCE	*trans*-1,2-dichloroethene
DNAPL	dense nonaqueous phase liquid
ERH	electrical resistance heating
FS	feasibility study
HHRA	human health risk assessment
LUC	land use control
LUCIP	Land Use Control Implementation Plan
MCL	maximum contaminant level
MDHSS	Missouri Department of Health and Senior Services
MDNR	Missouri Department of Natural Resources
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MIP	membrane interface probe
NCP	National Contingency Plan
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PP	proposed plan
PRG	preliminary remediation goal
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RRC	Regional Readiness Command
RSC	Regional Support Command
SVOC	semivolatile organic compounds
TAL	target analyte list
TCE	trichloroethene
TCH	thermal conductive heating
TTZ	target treatment zone
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

GLOSSARY OF TERMS

This glossary defines technical terms used in the PP. The terms and abbreviations contained in this glossary are defined in the context of hazardous waste management and apply specifically to the work performed under the CERCLA program. They may have other meanings when used in different context.

administrative record: The body of documents that forms the basis for the selection of a particular response action at a site.

annual operation and maintenance (O&M): The cost and timeframe of operating labor, maintenance, materials, energy, disposal, and administrative components of the remedy.

Applicable or Relevant and Appropriate Requirements (ARARs): Any federal and state standards, laws, requirements, criteria, or limitations that CERCLA remedial action must meet.

balancing criteria: Five of the nine CERCLA criteria used to further evaluate remedial alternatives. They are long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost.

bedding planes: Parallel layers of sediment or sedimentary rock that can be distinguished from each other by characteristics such as grain size and chemical composition.

bedrock: The native consolidated rock underlying the ground surface.

capital cost: The actual costs related to the labor, equipment, and material costs of construction.

Comprehensive Environmental Response, Compensation, and Liability Act (CECRLA): Superfund is the name given to the environmental program established to address abandoned hazardous waste sites. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites, provided for liability of persons responsible for releases of hazardous waste at these sites, and established a trust fund to provide cleanup when no responsible party can be identified.

cone penetrometer test (CPT): An in situ testing method used to determine geotechnical engineering properties of soils and delineating soil stratigraphy. It involves pushing a conical-shaped probe into a soil deposit and recording the resistance of the soil to penetration.

chemicals of concern (COCs): Chemicals at a site that present and unacceptable risk to human health or the environment and require response action.

chemical oxidant: A chemical agent that causes the loss of electrons or an increase in oxidation state by a molecule, atom, or ion.

chemical reductant: A chemical agent that causes the gain of electrons or a decrease in oxidation state by a molecule, atom, or ion.

chlorinated volatile organic compound (cVOC): A VOC containing one or more chlorine atoms it its chemical structure.

decision document: A legal document issued, following the RI and FS, which sets forth the selected remedy for cleanup of a site as decided by the authorized decision maker for the lead federal agency.

dense nonaqueous phase liquid (DNAPL): Non-aqueous phase liquids such as chlorinated hydrocarbon solvents with a specific gravity greater than 1.0 that sink through the water column until they reach a confining layer. Because they are at the bottom of aquifers instead of floating on the water table, typical monitoring wells do not indicate their presence.

ecological risk assessment: A study of the actual or potential danger to the environment from hazardous substances at a specific site. The ecological risk assessment estimates nonhuman health risk if no response action is taken.

electrical resistance heating (ERH): An in-situ remediation technology that applies electricity into the ground through electrodes to heat the subsurface and vaporize contaminants, enhancing the cleanup of soils contaminated with VOCs and SVOCs.

exposure: Chemical contact by a receptor.

exposure pathway: The route by which a receptor may come into contact with a chemical. An exposure model identifies pathways and routes by which a receptor group may be exposed to chemicals based on a hypothetical "complete" exposure pathway. The following five elements are needed to form a complete exposure pathway:

- Chemical source
- Mechanism of chemical release to the environment
- Environmental transport medium (air, groundwater) for the released chemical
- An exposure point (point of contact between the impacted medium and the receptor)
- Exposure route (for example, ingestion of groundwater) at the exposure point

If any element is missing, the exposure pathway is incomplete, and no intake (or subsequent health risk) associated with the pathway may exist.

feasibility study (FS): A comprehensive evaluation of potential alternatives for remediating contamination. It identifies general response actions, screens potentially applicable technologies and process options, assembles alternatives, and evaluates alternatives in detail.

field gas chromatography: A field instrument used for the analysis of VOCs in water, soil, soil gas, and ambient air for the purpose of site characterization, verify cleanup activity, determine correct personal protective equipment, and monitor ambient air during removal or remediation activities.

five-year review: Reviews required by CERCLA Section 121 at sites where remedial actions result in hazardous substances, pollutants, or contaminants remaining at the site. Such reviews must be performed every five years or may be performed more frequently if necessary to ensure the protectiveness of the remedy.

groundwater: Water found below ground surface that fills pores between such materials as sand, silt, gravel, or rock.

groundwater gradient: The slope of the groundwater table at a particular point in the subsurface.

hazard index: A measure of the risk of adverse health effects associated with exposure to chemicals not known to cause cancer. A hazard index of 1 or less is considered highly unlikely to cause noncancer adverse effects even if exposure continues for a lifetime.

human health risk assessment (HHRA): A study of the actual or potential danger to human health from hazardous substances at a specific site. The HHRA estimates the risk to human health at the site if no response action is taken.

individual excess lifetime cancer risk: A measure of risk of adverse health effects associated with the exposure to cause cancer. An individual excess lifetime cancer risk of $1x10^{-5}$ is an upper bounded estimate of the probability that one additional case of cancer will occur in 100,000 people over a 70-year lifetime as a result of individual exposure to the chemical.

in situ: In the original position, not having been moved or transferred to another location.

land use controls (LUCs): Restrictions on land use to help minimize the potential for human exposure to contamination.

lean clay: clay of low to medium plasticity owing to a relatively high content of silt or sand.

lenses: Permeable, irregularly shaped sedimentary deposits surrounded by less permeable geologic materials.

maximum contaminant level (MCL): The maximum allowable concentration of a chemical in drinking water established by USEPA.

membrane interface probes (MIPs): A screening tool for locating VOCs in the subsurface which collects real-time, nearly continuous data on the distribution of VOCs as well as electrical conductivity log that is indicative of stratigraphy.

milligrams per kilogram (mg/kg): Units of concentration corresponding to 1 part per million.

modifying criteria: Two of nine CERCLA criteria used to evaluate remedial alternatives: namely state and community acceptance.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): Federal regulations specifying the methods and criteria for cleaning up sites under CERCLA, codified at 40 Code of Federal Regulations Part 300.

natural attenuation: The decrease of chemical concentrations over time through naturally-occurring processes that act without the need for human interaction.

overburden: Loose soil or other geologic material that lies above bedrock.

plume: A volume of groundwater affected by a contaminant source. Typically an elongated, mobile volume representing the extent of contaminated groundwater.

polychlorinated biphenyls (PCBs): A group of toxic, persistent chemicals used in electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as lubricant. The sale and new use of these chemicals, also known as PCBs, were banned by law in 1979.

polycyclic aromatic hydrocarbons (PAHs): A group of chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances.

preferred alternative: The cleanup approach proposed by the lead agency based on the information contained in the FS. The preferred alternative, as presented in this PP, is subject to change or revision based on public comment.

preliminary remediation goals (PRGs): Numerical goals set for each contaminated media (for example, seeps and groundwater) to help meet the RAOs.

present worth: The amount of money that would need to be invested today to fund a stream of expenditures at given points in time. O&M expenses are often calculated for their present worth, in order to compare different alternatives. Present worth is not just an addition of the yearly costs; it takes into account interest rates.

proposed plan (PP): A document requesting public input on a proposed remedial alternative.

reductive dechlorination: Degradation of chlorinated organic compounds, like TCE and *cis*-1,2-DCE, by chemical reduction with the release of inorganic chloride ions.

remedial action: Action taken to cleanup contamination at a site to acceptable standards.

remedial action objectives (RAOs): Medium-specific objectives for protecting human health and the environment (for example, groundwater and soil).

remedial investigation (RI): A detailed study of a site. The RI may include an investigation or air, soil, surface water, and/or groundwater to determine the source(s) and extent of contamination at a site.

remediation goals: Specific cleanup concentrations or levels based upon federal and state environmental laws and regulations or the health risk on a given site.

Resource Conservation and Recovery Act (RCRA): An act which gives the USEPA the authority to regulate hazardous and non-hazardous wastes.

semivolatile organic compounds (SVOCs): Carbon-based chemicals with higher vapor pressure than VOCs and therefore released as gas much more slowly from materials. It is likely to be transferred to humans by contact or by attaching to dust and being ingested.

steam-enhanced extraction: An in-situ remediation technique that extracts contaminants from the subsurface through steam injection into wells and extraction of hot fluids.

target analyte list (TAL): A list of 23 naturally occurring inorganic elements established by the USEPA: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

target treatment zones (TTZs): Areas where surface soil, sediment within powder wells, and groundwater require further action.

thermal conductive heating (TCH): An in-situ remediation technology that applies heat to the subsurface through heating elements to vaporize contaminants and enhance the cleanup of soils contaminated with VOCs and SVOCs

threshold criteria: The first two of the nine CERCLA criteria: overall protection of human health and the environment, and compliance with ARARs.

vapor intrusion: The movement of volatile chemicals in soil and groundwater into indoor air.

volatile organic compounds (VOCs): A carbon based compound with sufficiently high vapor pressure that it can be easily transferred from soil and/or water to air. It is most likely to be transferred to humans by inhalation.

weathered shale: Shale that has reacted with air and/or water near the Earth's surface.

zero valent iron: A strong chemical reductant that is used to chemically degrade cVOCs in groundwater.

REQUEST FOR COMMENTS

Your input on the PP for the former Hanley Area is important to USACE. Comments provided by the public are valuable in selecting a final cleanup remedy for the site.

You may use the space below to write your comments, then fold, and mail. Comments must be postmarked by December 29, 2010. If you have any questions about the comment period, please contact Ms. Josephine Newton-Lund at (816) 389-3912. Those with electronic communications capability may submit comments to Josephine Newton-Lund at the following electronic mail address: Josephine.M.Newton-lund@usace.army.mil.

COMMENT PROVIDED BY:

Name: ______________________________
Address: ______________________________
City: ______________________________ **State:** _____ **Zip:** _____

SUBMIT COMMENTS AND FURTHER INFORMATION TO:

United States Army Corps of Engineers
Attn: Josephine Newton-Lund
U.S. Army Corps of Engineers – Kansas City District
601 East 12th Street/CENWK-PM-ES
Kansas City, MO 64106

COMMENTS (attach additional pages for comments if needed)

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Proposed Remedial Alternative for the St. Louis Ordnance Plant, Former Hanley Area

Public Meeting
Julia Davis Branch Library
St. Louis, Missouri
December 13, 2010

U.S. Army Environmental Command

88th Regional Support Command

US Army Corps of Engineers
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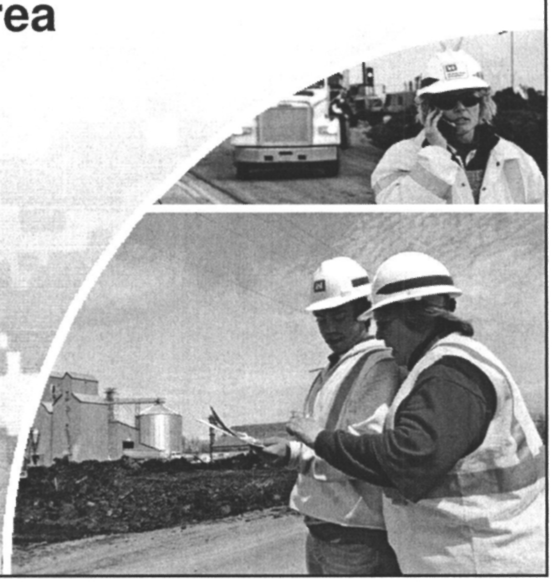

Meeting Agenda

- Introduce Project Team Members
- Summarize Site History
- Describe Environmental Investigation Findings
- Present the Proposed Remedial Alternative
- Record Public Comments and Answer Questions

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Project Team Members

- U.S. Army Environmental Command
- U.S. Army Corps of Engineers – Kansas City District
- 88th Regional Support Command
- Missouri Department of Natural Resources
- Missouri Department of Health and Senior Services
- U.S. Environmental Protection Agency, Region VII

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Roles and Responsibilities

Army Stakeholders

- U.S. Army Environmental Command (USAEC)
  - Provides management and oversight of cleanup activities
- U.S. Army Corps of Engineers – Kansas City District
  - Provides technical and contracting support to USAEC
- 88th Regional Support Command
  - Current property owner

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Roles and Responsibilities

Regulatory Stakeholders

- Missouri Department of Natural Resources (MDNR)
  - Lead regulatory agency
- Missouri Department of Health and Senior Services
  - Provides technical support to MDNR
- U.S. Environmental Protection Agency, Region VII
  - Provides regulatory assistance to MDNR

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Community Outreach Efforts

- In 2004, the Army set up an administrative record (AR) at the St. Louis Central Library.
  - The AR contains environmental investigation reports, the feasibility study, and the proposed plan for the former Hanley Area.
  - The Army provided public notice of the file's availability in local newspapers.
- In June 2006, the Army mailed nearby residents a letter notifying them of the upcoming groundwater investigation at the former Hanley Area.

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Community Outreach Efforts

- In September 2007, the Army mailed a letter to nearby residents notifying them that the Army would seek access to some properties to collect environmental samples.
- In March 2008, the Army mailed a survey to nearby residents asking for their input during the Army's preparation of the Community Involvement Plan.
- In November 2010, the Army mailed a letter and fact sheets to nearby residents, community organizations, churches, and local officials inviting them to tonight's public meeting. The letter noted that sampling might be needed on nearby residential properties.
- In November 2010, the Army moved the administrative record to the Julia Davis Branch Library (closer to the former Hanley Area).

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Site Description

- The former Hanley Area is 14.68 acres in size and located at the corner of Stratford Avenue and Goodfellow Boulevard.
- Most of the historic buildings have been demolished.
- The site is currently used for industrial purposes.
- The site is bordered by the Job Corps facility on the west, a residential neighborhood to the north, the Sverdrup U.S. Army Reserve Center to the south, and Goodfellow Boulevard to the east.

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Site History 1941 through 1945

- The site operated as a small arms ammunition production facility
  - Plant Area No. 1 – east of Goodfellow Blvd.
  - Plant Area No. 2 – west of Goodfellow Blvd.
- The former Hanley Area is at the northeastern end of Plant Area No. 2.
  - .30 and .50-caliber projectiles were manufactured.
  - In 1941, powder wells were installed to collect sediment prior to discharging wastewater to sanitary sewer.

Site History 1945 through 1959

- Following deactivation of the St. Louis Ordnance Plant in 1945, buildings containing explosives were decontaminated by the U.S. Army Corps of Engineers.
  - ► Limited records of the decontamination effort are available.
- Several buildings within Plant Area No. 2 were then used by the U.S. Department of Defense for maintaining service records and as classrooms.

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Site History
1959 through 1979

- The site was leased by Hanley Industries, Inc.
- Hanley used the site to research, develop, manufacture, and test various explosives.
  - Hanley made ordnance and non-ordnance devices for the U.S. military and the National Aeronautics and Space Administration (NASA).
  - Buildings were used to load detonators and primers and to mix explosives.
  - Explosive materials were dried in magazines (storage buildings) by exposing them to the air.
- Hanley ceased operations in 1979.

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Site History
1979 through Present

- The Army required Hanley to decontaminate buildings following lease termination in 1979.
- Several buildings were demolished in 2004, 2005, and 2007.
- Four onsite buildings remain: 219A, 219D, 219G, and 236.
  - Buildings are used for storage except for 219G, which is occupied during business hours.

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Environmental Releases

- Previous waste handling and disposal practices at the former Hanley Area released contamination into soil and groundwater.
  - ► Explosives manufacturing released metals (such as arsenic and lead) into soil.
  - ► Activities at the former Building 220 released chlorinated volatile organic compounds (such as carbon tetrachloride) into groundwater.
  - ► A leaking transformer released a polychlorinated biphenyl (PCB) into soil.

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Environmental Investigations

- Numerous investigations have been performed to assess the extent of environmental releases.
  - ► Investigations performed between 1991 and 2007 identified the extent of contamination in soil and groundwater.
  - ► A remedial investigation was performed in 2008 to further delineate the extent of contamination.
    - Surface soil samples, groundwater samples, and indoor air samples were collected.
    - Risk assessments were performed using data collected in 2008 and in previous investigations.

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Risk Assessment

- A human health risk assessment estimated the risks that onsite and offsite contamination posed to humans. Unacceptable risk was defined as:
  - an increased chance of developing cancer of greater than one in 100,000
  - a non-cancer hazard index greater than 1, meaning that adverse non-cancer effects could occur over a lifetime of exposure
- An ecological risk assessment evaluated risks to plants and soil invertebrates.

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Risk Assessment Findings

- Unacceptable human health risks were identified from:
  - Residential exposure to onsite surface soils (metals)
  - Residential exposure (through drinking) of onsite and offsite groundwater (volatile organic compounds)
    - Residents are protected from drinking groundwater by a City ordinance that prohibits the installation of potable water wells in the City of St. Louis.
  - Construction worker exposure to groundwater in excavations (volatile organic compounds)

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Risk Assessment Findings

- No current risks associated with contaminated indoor air were identified, but the potential for future risk (onsite and offsite) was identified.
- Ecological risks were found to be negligible.

Remedial Action Objectives

Remedial Action Objectives are specific goals for protecting human health and the environment. They were developed to address unacceptable risks and to guide site cleanup:

- Prevent unacceptable risk to future human receptors (onsite and offsite) from potential vapor intrusion to indoor air.
- Prevent unacceptable risk to residents from ingestion of onsite soil.
- Prevent unacceptable risk to onsite construction workers from dermal contact with groundwater containing specific volatile organic compounds.
- Remove soil to prevent future human exposure to onsite soil with elevated concentrations of arsenic, lead, and PCBs.
- Remove the sediment within onsite powder wells to prevent future human exposures.

Remedial Alternatives

The following remedial alternatives were evaluated:

- Alternative 1—No Action (required by law to be considered for comparison purposes)
- Alternative 2—In Situ Groundwater Treatment Using Thermal (Heating) Technologies, Soil and Powder Well Sediment Removal, and Offsite Disposal
- Alternative 3—In Situ Groundwater Treatment Using Chemical Processes and Soil Mixing, Soil and Powder Well Sediment Removal, and Offsite Disposal
- Alternative 4—Groundwater Source Removal by Excavation, Soil and Powder Well Sediment Removal, and Offsite Disposal

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Evaluation Criteria

- Overall protection of human health and the environment
- Compliance with "applicable or relevant and appropriate requirements" (laws and regulations)
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

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Preferred Remedial Alternative

- The preferred alternative is Alternative 3 (In Situ Groundwater Treatment Using Chemical Processes and Soil Mixing, Soil and Powder Well Sediment Removal, and Offsite Disposal).
- Alternative 3 is preferred because it protects human health and the environment, it provides for onsite treatment of groundwater (as opposed to excavation and offsite disposal), and it is cost-effective.

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Preferred Remedial Alternative

- **Remedy Components**:
  - In situ (in-place) groundwater treatment using chemical processes and soil mixing
  - Surface soil removal and offsite disposal
  - Powder well sediment removal and offsite disposal
  - Onsite groundwater monitoring for carbon tetrachloride
  - Vapor intrusion evaluation
  - Land use controls
  - Five-year site reviews

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In Situ Groundwater Treatment

- In the groundwater treatment zone, a chemical amendment will be mixed into soil to reduce volatile organic compound concentrations in groundwater.
- The anticipated chemical amendment is zero-valent iron (ZVI).
  - ZVI is made from recycled scrap iron.
  - ZVI chemically reacts with volatile organic compounds to transform the contaminants into less-toxic chemicals such as ethane, methane, and carbon dioxide.
- The chemical amendment will be mixed into the soil using a trenching machine or drill augers.

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Surface Soil Removal and Offsite Disposal

- Areas of surface soil contamination identified in previous investigations will be excavated to address metals and PCBs, and the soil will be properly transported and disposed of offsite in a permitted landfill.
  - Prior to excavation, soil samples will be collected to identify the extent and depth of each removal area.
  - Anticipated depth of excavation is 2 feet.
- Clean, imported material will be used to backfill each excavation.

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Powder Well Sediment Removal

- All onsite powder wells will be decommissioned.
- Powder well sediment will be removed and properly disposed of offsite based on sampling results.
- Wells will be filled with clean, imported backfill.

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Onsite Groundwater Monitoring for Carbon Tetrachloride

- Onsite groundwater concentrations of carbon tetrachloride (CT) are above the acceptable risk threshold for construction workers
  - However, groundwater lies more than 10 feet below the surface, which is the maximum depth considered for construction worker exposures.
- Groundwater depths and CT concentrations will be monitored onsite to confirm that construction workers are protected.
- Additional protection to construction workers will be provided by land use controls (see later slide).

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Vapor Intrusion Evaluation

- Please refer to the vapor intrusion fact sheet for more information on the potential exposure pathway.
- Groundwater will be monitored to assess possible future vapor intrusion into offsite residences. The first groundwater monitoring event was performed in August 2010.
- The Army will contact property owners whose homes should be sampled to assess the vapor intrusion pathway.
  - Sampling would consist of sub-slab soil vapor sampling, indoor air sampling, and outdoor air sampling.
- Vapor barriers or in-home mitigation systems will be implemented if the evaluation indicates that site-related contaminants pose a risk to nearby residents.

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Land Use Controls

- Land use controls (LUCs) are physical, legal, or other mechanisms that restrict property use.
- Two LUC areas will be established onsite.
  - Area #1 – Vapor intrusion evaluations will be required at building construction sites as long as groundwater concentrations remain above screening levels. Vapor mitigation measures in the new building if the evaluation indicates a possible vapor intrusion problem.
  - Area #2 – Proper health and safety training and personal protective equipment will be required for construction activities that are performed below the groundwater table.

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City of St. Louis Ordinance 66777

- The ordinance prohibits the use of groundwater within City limits as a potable (drinking) water supply.
- Although not part of the preferred remedy, this ordinance provides protection against exposure to contaminated groundwater.
  - ► Protects current and future residents from consuming potentially-contaminated groundwater .

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Five-year Site Reviews

- Five-year site reviews are performed by the Army and regulators, with community input, to assess whether the remedy continues to be protective of human health and the environment
  - ► These reviews are required as long as contamination remains in soil or groundwater at concentrations that do not allow for unlimited (e.g., residential) use and unrestricted exposure.
  - ► Chemical concentrations in groundwater are not expected to drop to acceptable levels for unlimited use and unrestricted exposure for at least 84 years.

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Questions / Comments?

- Please clearly state your name and the organization you are representing (if applicable). This will allow us to accurately record your question or comment.

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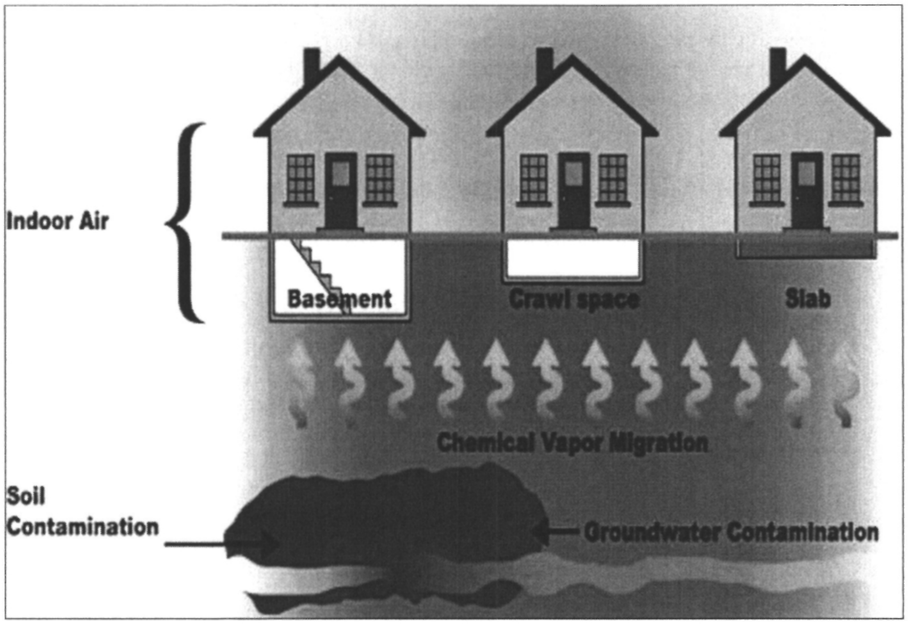
FACTS ABOUT...

VAPOR INTRUSION

What is vapor intrusion?

Vapor intrusion is a way in which chemicals in the ground can get into the air in your home (see figure at right). Chemicals are released to the soil and groundwater from various sources including: chemical spills at a factory, chemical dumping, leaks from underground storage tanks, or buried wastes. Certain types of chemicals evaporate and may travel as vapors through the soil and groundwater and into nearby buildings, contaminating indoor air.



A variety of factors can influence whether vapor intrusion may occur at a building located near a source of soil or groundwater contamination including: soil type, depth to groundwater, the construction of the building, and the condition of the foundation and existence of underground utilities that can create pathways for vapors to travel. Homes in the same neighborhood and even next door to each other can be affected differently by vapor intrusion.

Why is vapor intrusion a concern?

Vapor intrusion is a concern because chemical vapors affect indoor air quality and can build up to a point where the health of occupants in affected buildings could be at risk. In general, exposure to any chemical does not necessarily mean that health effects will occur. Whether or not a person experiences any health effects depends on several factors, including the toxicity of the chemical, the length and amount of exposure, and the health and sensitivity of the individual exposed. If chemical levels build up in indoor air high enough, individuals may temporarily experience eye and respiratory irritation, headache, and/or nausea. Low-level chemical exposures over many years may increase an individual's risk of developing cancer or chronic disease.

What types of chemicals are associated with vapor intrusion?

Only "volatile" chemicals that readily evaporate are a concern with vapor intrusion. The most common class of chemicals associated with vapor intrusion are volatile organic compounds (VOCs). VOCs are widely used and are found in petroleum products such as gasoline and solvents for dry cleaning and industrial uses.

Can vapors be in my home from other sources?

VOCs also are found in many household products and can affect indoor air quality. Paints, paint strippers and thinners, cigarette smoke, aerosol sprays, moth balls, air fresheners, new carpeting or furniture, hobby supplies (glues and solvents), stored fuels, and clothing that has been dry-cleaned all contain VOCs. Such household sources are more likely to be a cause of indoor air quality problems in your home than vapor intrusion.

In addition, indoor air quality may also be affected by outdoor air. VOCs are present in outdoor air from a combination of sources such as vehicle exhaust and various industries.

Both indoor and outdoor sources are taken into account when evaluating whether vapor intrusion is contributing to unhealthy indoor air.

What happens if vapor intrusion is a concern near my home?

If you live near a site with VOC contamination, the potential for vapor intrusion may be investigated. To determine whether vapor intrusion may be a concern, samples of groundwater and soil gas may be collected near your home. If this sampling indicates a potential problem, sampling on your property and in your home may be necessary.

If such sampling is necessary, you would be contacted by the site owner or others working on the investigation and cleanup with information about the project. Your cooperation and consent would be requested before any testing or sampling is done on your property. Additionally, such sampling would be done at no cost to you.

Soil gas samples collected beneath the foundation are often the most reliable method to determine if vapors are present that could cause a problem. Indoor and outdoor air sampling may also be collected. A comparison of all the data is conducted to determine whether vapor intrusion is a concern.

Depending on the investigation results, additional sampling or monitoring may be recommended. Additional sampling may be performed to determine the extent of vapor contamination and to verify results. Monitoring (sampling on a recurring basis) may be conducted if there is a potential for vapor intrusion to occur should conditions change.

What happens if a vapor intrusion problem is found?

If testing confirms vapor intrusion is affecting the air in your home, measures can be taken to address the problem. Mitigation steps may be taken to minimize exposures associated with vapor intrusion. Mitigation steps may include sealing cracks in the building's foundation, adjusting the building's heating, ventilation, and air-conditioning system to maintain a positive pressure to prevent infiltration of subsurface vapors, or installing a subsurface depressurization system. This system prevents vapors from entering the building by continuously venting the vapors from beneath the building to the exterior of the structure. Subsurface depressurization systems are also used throughout the country to reduce levels of naturally-occurring radon gas. This system uses minimal electricity and should not noticeably affect heating and cooling efficiency. Usually, the party responsible for cleaning up the contamination is also responsible for paying for installation of this system. The system typically remains in place until the contamination is cleaned up and may remain in place permanently.

What can I do to improve my indoor air quality?

Household products and other factors, such as mold growth, carbon monoxide, and radon, can degrade the quality of air in your home. Consider the following tips to improve indoor air quality:

- Be aware of household products that contain VOCs. Do not buy more chemicals than you need at a time. Store unused chemicals in tightly-sealed containers in a well-ventilated location, preferably away from the living space in your home.
- Fix all water leaks promptly, as well as other moisture problems that encourage mold growth.
- Don't make your home too air tight. Fresh air helps prevent build-up of chemicals in the air as well as mold growth.
- Check all appliances and fireplaces annually. Make sure they are properly vented and in good condition.
- Install carbon monoxide detectors in your home; take immediate actions to reduce carbon monoxide levels if needed. These detectors are available at hardware and home improvement stores.
- Test your home for radon; take actions to reduce radon levels if needed. Test kits are available at hardware and home improvement stores or you can call the DHSS Radon Program at (573) 751-6160 or (866) 628-9891.

For more information:

For health-related questions regarding vapor intrusion, please contact:

Missouri Department of Health and Senior Services, Health and Risk Assessment Program (573) 751-6102

Additional information about vapor intrusion is available at the following Web sites:

- U.S. Environmental Protection Agency—www.epa.gov/epawaste/hazard/correctiveaction/eis/vapor.htm
- Interstate Technology and Regulatory Council—www.itrcweb.org/guidancedocument.asp?TID=49

Additional information on indoor air quality is available at the following Web sites:

- DHSS—www.dhss.mo.gov/IndoorAir
- U.S. Environmental Protection Agency—www.epa.gov/iaq

REQUEST FOR COMMENTS

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COMMENT PROVIDED BY:

Name: ______________________________
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COMMENTS (attach additional pages for comments if needed)

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